Amendments to the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification. A marked-up version of the Substitute Specification and Abstract is attached hereto.

SPECIFICATION

TITLE OF THE INVENTION

METHOD OF PACKAGING A FROZEN DESSERT

BACKGROUND OF THE INVENTION

The invention relates to a method of packaging a thick but malleable frozen dessert, and for dispensing it under pressure in the expanded state, it being possible for the degree of expansion to be chosen independently of the consistency of the said dessert.

SUMMARY OF THE INVENTION

When it is desired to dispense a frozen dessert in the expanded state, that is to say in aerated form, it is known by Patent US A 4 421 778 to foam an ice-cream or milkshake mix in order to expand it, to fill receptacles with portions of the expanded mix, which receptacles are then placed in a freezer and where the product is then preserved at freezing temperature. The product is spoonable at this temperature. In fact, the step of foaming at a positive temperature with the introduction of air creates an expanded state which is not stable. There is no indication that the product can be introduced into a pressurized container or can be dispensed at the cold storage temperature from this container in the form of a frozen dessert in a stable expanded state.

Moreover, a method and an apparatus making it possible to introduce an expansion gas, nitrogen dioxide, into a liquid, therefore not frozen, mix at a high pressure for the purpose of entraining enough gas into the ice-cream in order to produce the desired expanded state is known, for example, from Patent US A 4 659 575. The non-frozen mix which has been subjected to this pre-aeration is then withdrawn from a mixing tank containing it to a container for dispensing it after enough gas has been entrained, then it is subsequently frozen at the dispensing location.

To avoid the drawback of the instability of the expanded state of a liquid mix, it would be conceivable to put the product to be packaged in the liquid state into the packaging receptacle and then to introduce into this receptacle a propellant gas which is slightly soluble in the said liquid product, after which the receptacle would be cooled to the dispensing temperature of the

product, at which temperature it is pasty; in this case, the product is packaged in the unexpanded, pasty state and it is extruded under the thrust of the propellant gas: at the outlet of the dispensing member, the product would be put in the expanded state by the expansion of the propellant gas dissolved in the said product. However, this procedure is not satisfactory for two reasons:

- on the one hand, the amount of propellant gas dissolved in the product is difficult to control, such that the expanded state obtained is not constant and that the amount of gas remaining available for propulsion of the product is therefore not constant either; and

- on the other hand, the amount of propellant gas dissolved in the product is obviously dependent on the gas pressure, which is imposed by the extrudability of the pasty product, hence the result is that, for a given product, the expanded state likely to be obtained on dispensing it is necessarily linked to the pressure of the propellant gas and to the nature of the said gas.

The aim of the present invention is to provide a method of packaging and dispensing a thick but malleable frozen dessert, by means of which, on the one hand, it is possible to package the said product in a pressurized receptacle with a high enough pressure given the viscosity of the product, and, on the other hand, it is possible to choose the degree to which the product is expanded at the output of the pressurized receptacle independently of the pressure required for propulsion of the product from the receptacle and of the speed at which the product comes out of the receptacle.

By virtue of such a method, it especially becomes possible to dispense a frozen dessert, such as the one described for example in European Patent EP B 878 998 or in French Patent Application FR 02 05620, by choosing the degree of expansion that is desired for the product dispensed at the outlet of the receptacle; in fact, it is desirable not to dispense such a frozen dessert in the form of a compact paste, but it is also desirable to prevent dispensing in the form of a foam which is too aerated.

The invention is partly based on the fact that two different gases are chosen for dispensing, of which one has the propulsion function and the other the expansion function. The

propellant gas is virtually insoluble in the product to be dispensed when in the liquid state while the expansion gas is highly soluble in the said liquid product. The expansion of the dispensed product will then be dependent on the amount and on the solubility of the expansion gas introduced into the receptacle, while the ejection of the product will depend on the pressure of the propellant gas introduced into the receptacle.

Consequently, the subject of the present invention is a method of packaging a thick but malleable frozen dessert, and for dispensing it under pressure in the expanded state, in which method the product is placed in a container equipped with a dispensing member, then, after having put the said dispensing member in the closed position, the said container is pressurized by a propellant gas to a pressure high enough to ensure suitable dispensing, given the consistency of the product to be dispensed and characteristics of the dispensing member, characterized in that:

a) a propellant gas which is virtually insoluble in the product to be dispensed is chosen;

b) an expansion gas which is different from the propellant gas and highly soluble in the product to be dispensed is chosen in order to expand the product when it is dispensed, the amount of expansion gas used being defined depending on the degree of expansion desired on dispensing, the expansion gas being homogeneously dissolved in the product to be dispensed by putting the expansion gas in contact with the said product in a freezer and

c) the passage of the said product takes place in the pasty state then it is dispensed by opening the dispensing member, the said product being expanded up to the desired degree, determined prior to filling, as described in step 1b, by expanding the expansion gas which is completely dissolved therein.

To implement the method, an ice-cream mix is treated in a freezer which is supplied with expansion gas so as to partially freeze and expand the said mix, under temperature and pressure conditions promoting good dissolution of the expansion gas in the said mix. In practice, it is preferred to operate at a temperature of about -8°C to -12°C at the output and at a constant pressure equal to atmospheric pressure up to 10 bars above atmospheric pressure in the freezer.

A gas that is highly soluble in the mix, preferably chosen from nitrous oxide (N_2O) and carbon dioxide, is used as an expansion gas.

The partly frozen and partly expanded mix is placed in the container by means of a metering device maintaining the initial pressure in the pipes and in the metering unit, for example by exerting a counterpressure upstream from the dispensing member. This way of proceeding makes it possible to limit the expansion of the volume of the product during filling by partial expansion of the expansion gas.

According to a first embodiment of the filling step of the method, a metering nozzle moving with an up and down movement is used as filling device, allowing filling by rising from the bottom of the containers, of the type called "bottom-up filler", so as to maximize the filling and to prevent the formation of pockets free of product. The container is filled, then closed by the dispensing member, sufficiently quickly to limit the expansion.

In a second embodiment, the product is filled through the dispensing member fixed beforehand to the container. In this case, the piston is positioned in the top of the container, against the dispensing member, so as to limit the pockets of air in the product. This second embodiment is preferred, since it is more efficient in limiting the expansion at the time of filling.

In the method which has been defined above, a rigid receptacle is used as container, into which, on the one hand, the product to be packaged which contains the amount of expansion gas needed to obtain the desired expanded state of the dispensed product is introduced, and, on the other hand, the propellant gas is introduced at the pressure desired for the dispensing.

According to a first implementational embodiment of the method, a rigid cylindrical receptacle is used as container, in which receptacle a sliding piston is placed, which divides the receptacle into two compartments, one of which is closed by the dispensing member while the other has a valve enabling the propellant gas to be injected and the pressure to be maintained, the product containing the expansion gas being introduced into the receptacle before it is closed by the dispensing member, or through the dispensing member itself.

According to a second implementational embodiment, a rigid receptacle containing a flexible pouch is used. The container is equipped, on one side, with a dispensing member connected to the pouch, and, on the other side, with a valve allowing the propellant gas to be injected and the pressure of the container to be maintained.

According to this second implementational mode, the rigid receptacle equipped internally with the flexible pouch connected to the outside by the dispensing member secured to the receptacle is used as container, the product containing the expansion gas is placed in the receptacle, through the dispensing member, inside the pouch and the propellant gas is then injected into the rigid receptacle through the valve, outside the pouch.

In the first implementational mode, it is possible, since a food product is to be packaged and dispensed, to use a metal receptacle and sliding piston which could undergo a conventional sterilization treatment without any difficulty; advantageously, the receptacle and the sliding piston consist of the same metal, which prevents any problem of differential expansion and maintains good sliding of the piston in the receptacle. However, the piston may also be made from a plastic, for example from a polyolefin, it being understood that since the product to be dispensed is a food product, the plastic used must be authorized for food packaging.

Advantageously, in this variant, a piston capable of sliding in the receptacle is used and the propellant gas is injected via the valve, the piston then bearing on the product: the degree of expansion of the dispensed product is determined by the amount of expansion gas contained in the product injected by the dispensing member (expressed in l of gas per 100 l of ice-cream mix for example) and the pressure is defined in order to optimize the time for filling the receptacle. Before injecting the propellant gas at a pressure greater than the pressure in the product compartment, the product to be dispensed, charged, at a pressure greater than atmospheric pressure, with partially dissolved expansion gas, is prepared and, the said charged product is metered into the container and the propellant gas is injected into the said container in order to pressurize the product to be dispensed to a pressure greater than that for filling of the product.

Since the product to be dispensed is a food product, in order that the product is preserved satisfactorily during storage, acceptable propellant and expansion gases must of course be chosen, bearing in mind existing food standards; according to the invention, nitrogen (N_2) or air having a dewpoint less than the minimum temperature to which the container will be exposed between manufacture of the product and its use can advantageously be chosen as propellant gas, and nitrous oxide (N_2O) as expansion gas.

According to the invention, it has been found that good results were obtained with regard to the expansion degree and its stability when 80 to 200 l of expansion gas, especially N_2O, per 100 l of mix were used. Thus, expansion of about 5 to 35% by volume was obtained at the freezer (depending on the pressure in the said freezer) and about 50 to 100% by volume in the final product delivered. This difference in expansion is due to the fact that most of the expansion gas is dissolved in the freezer during the expansion and freezing operation. This gas partially comes out of solution on leaving the freezer and much more strongly in the dispensing member of the container on dispensing at ambient pressure. It is advantageous according to the invention to check that the expansion is as small as possible during filling so as to maximize the amount of product metered into the containers. On the other hand, it will be advantageous for the product leaving the dispensing member to have an expansion comparable to that which is common in ice-creams. This results from increasing the amount of product metered at constant volume. The best results were obtained at a constant pressure of about 4 to 5 bar in the freezer and by maintaining a counterpressure of the same order, in the pipes feeding the metering element and in the latter.

In order for the subject of the invention to be better understood, two implementational embodiments, shown schematically in the appended drawing and corresponding to the packaging of a frozen dessert, will now be described by way of purely illustrative and non-limiting examples.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the figures.

BRIEF DESCRIPTION OF THE FIGURES

Figures 1 to 3 and 7 and 8 show the steps of a first variant of the method according to the invention,

Figures 4 to 6 show the steps of a second variant of the method according to the invention, and

Figures 9 to 11 show various types of valves for filling with the propellant gas which can be used in the method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawing, it can be seen that, for all of the figures, a cylindrical metal container is denoted overall by 1 and comprises a bottom and an upper part 2 attached by crimping to the side wall of the said container; in the central region of this part 2, a dish is also attached by crimping, which dish bears, in its centre, a dispensing member 3 comprising a rotating mechanism, which allows it to be opened and closed, by action on a manoeuvring fin 3a. Although this is not described in the examples corresponding to Figures 1 to 3, a translatable pusher could of course be used in place of the aforementioned rotating mechanism. Such a pusher is shown in connection with Figures 7 and 8. The dispensing member 3 comprises, at the outlet, a nozzle to shape the cross section of the column of dispensed product. The packaged product is in the pasty state, and is thick but malleable. For the two variants shown in the drawing, the propellant gas used is nitrogen or compressed air having a dewpoint less than the minimum temperature to which the container will be exposed between manufacture of the product and its use, and the expansion gas is nitrous oxide.

In the following examples, the product placed in the receptacle 1 has the following formulation (% by weight):

Fat	10.9%
Powdered whole milk	7.35%
Derivatives of dairy origin	10.9%
Glucose and glucose syrup	16.1%
Emulsifier	0.38%

Thickener	about 0.13%
Egg white	0.05%
Colourings and flavourings	0.08%
Water	54.11%

Before the product is placed in the container 1, the said receptacle can be sterilized in a known manner, given that the packaged product is a food product.

Before being treated in the freezer, the mix is preferably desaerated under negative pressure (vacuum) in order to free it from the gas which may have been incorporated in it during its preparation. In this way it is possible to incorporate into the mix constant quantities of soluble expansion gas, e.g. nitrous oxide.

This measure allows to avoid density and expansion variations during filling, which could impair filling of a given required amount of product into the container.

In addition, this step has the advantage to allow direct recycling of the mix which would not be filled in, in case of stop of the filling line if the filling process was interrupted.

Before putting it in place, the product, whose mix formulation has been given above, is treated in a freezer at a temperature of -8.5°C to -10°C, supplied with nitrous oxide instead of the air normally used for expansion, the amount of nitrous oxide introduced into the mix being from 140 to 145 l of N_2O per 100 l of mix. The product coming out of the freezer is packaged in the container 1 at a pressure of 4 to 5 bar. The propellant gas (nitrogen or compressed air having a dewpoint less than -40°C) is then introduced at a pressure of about 10 bar through the valve 4. Once the product has been packaged, the product is brought to a temperature of -15°C to -20°C, preferably of less than or equal to -18°C, at which temperature the said product is in the pasty state. The internal volume of the empty container 1, without piston and without dispensing member, is about 0.8 litre and the volume of product introduced into the container for subsequent dispensing is about 0.6 litre. This corresponds to about 0.9 litre of finished aerated soft ice cream dispensed out of the container.

Figures 1 to 3, 7 and 8 show the various steps of the first variant of the method according to the invention. In this variant, the container 1 has a valve 4 in its base and, internally, it has a

sliding piston 5 (see Figure 1). In the drawing, for the purpose of simplification, a piston 5, whose circular face is flat is shown; however, in a known manner, a piston can be used whose circular face is shaped so as to have, at its centre, a cavity allowing the part of the dispensing member 3 which projects inside the container 1 to be housed: in this way, the emptying rate of the receptacle during dispensing is improved.

In a first example, the half-frozen unexpanded product P is put in place in the container without the dish bearing the dispensing member 3 by means of a filling nozzle 6 moving with an up and down movement in the direction of the arrow f1, the filling being carried out from the bottom up by vertical translational movement of the filling nozzle 6. The filling is carried out rapidly and, when the container is full, the dish bearing the dispensing member 3 is crimped (put in place in the direction f2). The piston 5 is then in the low position (see Figure 2) and the pressure is P1. Nitrogen at a pressure P2 equal to about 8-10 bar (or compressed air having a dewpoint equal to or less than -40°C) is injected below the piston 5, the introduction taking place through the valve 4 (see Figure 3).

The temperature of the product in the container 1 is then lowered to a temperature of -15°C to -20°C, preferably equal to or less than -18°C, by passing the container filled with the product through a freezing tunnel, the temperature of which is -35 to -38°C, the product to be dispensed thus taking on its pasty dispensing consistency. The product is thus stored and used by the consumer at a temperature of -15°C to -20°C.

In a second example, the product P is filled through the dispensing member 3 fastened beforehand to the container 1, as illustrated in Figure 7. In this case, the piston 5 is positioned before filling in the top of the container, against the dispensing member. As the product P is introduced into the container, the piston 5 moves towards the bottom of the container 1 in the direction of the arrow F1. The air contained between the piston and the bottom of the container is expelled through the valve 4. This method of proceeding makes it possible to limit the pockets of air in the packaged product. The piston 5 is then in the low position (Figure 8) and the pressure is P1. Nitrogen at a pressure P2 equal to about 8-10 bar (or compressed air having a dewpoint equal

to or less than -40°C) is injected below the piston 5, the introduction taking place through the valve 4 (Figure 8).

The temperature of the product in the container 1 is then lowered to a temperature of -15°C to -20°C, preferably equal to or less than -18°C, by passing the container filled with the product through a freezing tunnel, the temperature of which is -35 to -38°C, the product to be dispensed thus taking on its pasty dispensing consistency. The product is thus stored and used by the consumer at a temperature of -15°C to -20°C.

The filling mode described in this second example is preferred, since it is more efficient in limiting the expansion of the product at the time of filling. In the second variant shown in Figures 4 to 6, the container 1 has a valve 4 in its bottom, through which the propellant gas (nitrogen or compressed air having a dewpoint less than the minimum temperature to which the container will be exposed between manufacture of the product and its use) can be injected. Where the dish which bears the dispensing member 3 has been crimped onto the container 1, a flexible pouch 8 (see Figure 4) has been fastened inside the container 1. The partially frozen and expanded product P is then introduced into the pouch 8 through the dispensing member 3 in the open position (see Figure 5). The dispensing member 3 is closed and the propellant gas is injected at a pressure of 8 to 15 bar, preferably of 8 to 10 bar through the valve 4 (see Figure 6). During filling, the pressure in the container 1 has therefore passed from atmospheric pressure to the pressure P1 10 bar above atmospheric pressure, then to the pressure P2 of 8 to 15 bar, preferably of 8 to 10 bar above atmospheric pressure by the final injection of the propellant gas.

Several solutions for the valve systems 4 are known and have been used in the examples described.

The first type, known by the name "Nicholson valve", is illustrated in Figure 9. In this case, the valve is applied to the bottle before injection of the propellant gas, so as to be only partially engaged in the orifice made in the bottom of the container. The valve allows the propellant gas to pass at the time of the injection, then the valve is thrust into the orifice so as to close it completely and to maintain the pressure in the container.

The second type is known by the name "umbrella valve" and is described in Figure 10. This valve may also be inserted into the orifice made for this purpose under the container before filling. The valve allows the propellant gas to pass at the time of injection, then, under the effect of the pressure created in this way in the container, the valve closes the orifice so as to maintain the pressure in the container.

In the third case, a "rope bung" valve, described in Figure 11, the propellant gas is injected into the orifice made for this purpose in the bottom of the container, then the valve (which in this case is more like a plug) is inserted into the orifice so as to close it and to maintain the pressure in the container.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.